



The threatened epixylic bryophytes in old primeval forests in Finland

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The rapid decrease and fragmentation of primeval forests in Finland has caused a serious threat to bryophytes that grow on decaying wood. Most of these epixylic bryophytes have specific site preferences and are sensitive to changes in the forest microclimate caused by intensive forest management. According to the Finnish Committee for the Conservation of Threatened Animals and Plants, thirteen epixylic bryophyte species are considered threatened in Finland. The latest records and remarks on the ecology and the status of one threatened epixylic moss (*Buxbaumia viridis*) and twelve hepatics (*Cephalozia lacunculata*, *C. affinis*, *C. macounii*, *C. catenulata*, *Calypogeia suecica*, *Scapania massalongi*, *S. apiculata*, *Nowellia curvifolia*, *Harpanthus scutatus*, *Anastrophyllum michauxii*, *Lophocolea cuspidata* and *Jungermannia leiantha*) are given.

INTRODUCTION

Thirteen epixylic bryophyte species, *Buxbaumia viridis* (DC.) Moug. & Nestl., *Cephalozia affinis* Steph., *C. catenulata* (Hüb.) Spruce, *C. lacunculata* Spruce, *C. macounii* (Aust.) Aust., *Nowellia curvifolia* (Dicks.) Mitt., *Harpanthus scutatus* (Web. & Mohr) Spruce, *Scapania massalongi* (K. Müll.) K. Müll., *S. apiculata* Spruce, *Calypogeia suecica* (Arn. & Perss.) K. Müll., *Anastrophyllum michauxii* (Web.) Buch, *Lophocolea cuspidata* (Nees) Limpr. and *Jungermannia leiantha* (Grolle), are considered threatened in Finland (Rassi & Väisänen, 1987). All grow in old spruce-dominated *Picea abies* (L.) Karsten forests. The special ecological demands of these rare epixylic bryophytes and the causes of their decline in Finland are discussed in this paper.

BIOLOGY AND ECOLOGY OF THREATENED EPIXYLIC BRYOPHYTES

The biology and ecology of the epixylic bryophytes are so far poorly known. Some general features of their ecology are, however, obvious. They require constantly humid, shady microclimate (Söderström, 1987; see also Clausen, 1952), characteristic under

the closed canopy of old spruce forests. In slightly paludified spruce mires the forest microclimate is especially favourable for epixylic hepatic species. The main substrate requirement of epixylic bryophytes is the decay stage of the wood (Andersson, 1987; Söderström, 1988a). Although species may colonize early and remain until late decay stages, each has a maximum frequency and abundance in a certain stage of decay (Söderström, 1988a).

Many epixylic bryophytes frequently reproduce sexually (Söderström, 1989). However, the small size of the plants, the location of the decaying logs on the forest floor, where air currents are weak, and probably also the relatively large asexual propagules, reduce their long-distance dispersal ability. Most of the rare and threatened epixylic bryophytes may be considered 'satellite species' (Hanski, 1982; Söderström, 1989), which are limited by inefficient dispersal and by difficulties in establishing themselves (Söderström, 1989).

THE MAIN THREATS TO EPIXYLIC BRYOPHYTES

The forest microclimate changes after deforestation and drainage (Hämet-Ahti, 1983). The temperature extremes and the drying effect of wind increase, drainage lowers the surface water, and moist logs and stumps dry out. The removal of

dead and fallen trees from the forests reduces the amount of available substrate for epixylic bryophytes (Andersson, 1987; Söderström, 1988b). Consequently, the main reason for their rarity in managed forests is the shortage of suitable substrate (Andersson, 1987). In addition, increasing distances between the fragments of primeval forest reduce the possibilities for these bryophytes to colonize new areas (Söderström, 1988b; see also Ehrlich, 1990).

The diversity of the epixylic bryoflora declines as a result of intensive forestry (Andersson, 1987; see also Peet *et al.*, 1983; Ehrlich, 1990). Many species suffer from changes in forest microclimate after forest management (Söderström, 1987, 1988b), although some species may benefit from the reduced competition. Forest continuity has been broken by fires (Zackrisson, 1977; Hämet-Ahti, 1983) and by man's activities (Hämet-Ahti, 1983; Linkola, 1988), but the recent fragmentation of primeval forests in Finland has accelerated the loss of suitable habitats, in particular decaying logs, a characteristic component of the vegetation of such forests, and which provide habitats for many threatened fungi and invertebrates (Rassi & Väisänen, 1987).

THE THREATENED EPIXYLIC BRYOPHYTE SPECIES

According to the Finnish Committee for the Conservation of Threatened Animals and Plants (Rassi & Väisänen, 1987), one epixylic moss species and eight hepatic species are considered threatened in Finland. Four epixylic hepatic species will be added to the revised national list of threatened bryophytes to be published in 1992. Nine of these thirteen species are also threatened in Sweden (Floravårdskommittén för mossor, 1988).

The threatened Finnish bryophytes are grouped below in categories modified from the IUCN Red Data List in Rassi and Väisänen (1987). If the status of the species has been changed in the revised list, this is mentioned after the species name. Those species to be added to the revised list are also included. The latest records are based on the material in the herbarium at Turku University (TUR), Botanical Museum Oulu (OULU) and Botanical Museum, Helsinki, (H) and on the field data obtained by P. Mattila, S. Piippo, J. Rikkinen, K. Syrjänen and S. Laaka during 1987–1990.

Biogeographical provinces (see Buch, 1936) are given for latest records. The nomenclature follows Koponen *et al.* (1977).

Disappeared (D)

These species have not been encountered in Finland after 1950 despite searches, and are considered to have disappeared from the country.

Lophocolea cuspidata (Nees) Limpr. (New category V). Latest records: Satakunta 1989, Regio aboensis 1990.

L. cuspidata was considered to have disappeared from Finland (Rassi & Väisänen, 1987), until it was found in two new localities in the southwestern archipelago, on the northern limit of its range; it is common in Central Europe (Järvinen, 1975).

Scapania massalongi (K. Müll.) K. Müll. Disappeared also from Sweden (Floravårdskommittén för mossor, 1988). Latest records: Karelia australis 1900.

S. massalongi has not been found in Finland since 1900 despite searches. It is rare and little known everywhere in its range (Schuster, 1974).

Endangered (E)

These species are in danger of disappearance from Finland in the near future.

Cephalozia lacinulata Spruce (New category D). Disappeared also from Sweden, (Floravårdskommittén för mossor, 1988). Latest records: Alandia 1925.

C. lacinulata has only been found twice in Finland. It will be moved to category D, because despite searching it has not been encountered since 1925.

Vulnerable (V)

The future existence of these species in Finland is uncertain, and they will become endangered unless the reason for their decline is removed.

Cephalozia affinis Steph. (New category Mp). Latest records: Regio aboensis 1940.

C. affinis has a southern distribution in Finland (Buch, 1936). Bomansson (1900) reported it as very rare in Alandia. According to Söderström (1989) it is relatively frequent on logs of late-decay stages in old coniferous forests in northern Sweden. In Finland, however, *C. affinis* has not been found since 1940. Because of its

uncertain taxonomic position (see, for example, Smith, 1990) it will be moved to category Mp, insufficiently known species which need special monitoring (Rassi & Väisänen, 1987).

Cephalozia macounii (Aust.) Aust. (New category E). Endangered also in Sweden (Floravårdskommittén för mossor, 1988). Latest records: Tavastia australis 1967, Ostrobothnia kajanensis 1989.

C. macounii was found in a new locality in Ostrobothnia kajanensis in 1989. It has not, however, been found again in old localities, for example that in Tavastia australis. The new locality is at the edge of a deforested area, and the stand of *C. macounii* there is very small.

Thus *C. macounii* will be moved to category E. *Cephalozia catenulata* (Hüb.) Spruce. New species on the Finnish list of threatened bryophytes. Included in category 4 in Sweden (Floravårdskommittén för mossor, 1988). Latest records: Lapponia enontekiensis 1968.

Although the latest record of *C. catenulata* is from northern Finland, its general distribution in this country is southern (Buch, 1936). Bomanesson (1900) reported it to be rare in Ålandia. Because of its habitats in moist natural forests, *C. catenulata* will be included in the revised list of threatened bryophytes in Finland.

Harpanthus scutatus (Web. & Mohr) Spruce. Rare in Sweden (Floravårdskommittén för mossor, 1988). Latest records: Tavastia australis 1987, Nylandia 1988, Ostrobothnia borealis 1989, Tavastia borealis 1990.

There are relatively many recent records of *H. scutatus* from Finland. The stands are, however, often very small and weak. In all the recent localities it grows on wet logs in spruce mires, although it may also occur on moist cliffs (see also Järvinen, 1975).

Scapania apiculata Spruce. Included in category 4 in Sweden (Floravårdskommittén för mossor, 1988). Latest records: Tavastia australis 1962, Tavastia borealis 1990.

S. apiculata is a poor competitor, which mostly grows on newly fallen conifer logs (Schuster, 1974). It is a tiny hepatic which may easily be overlooked. Because of its special ecological demands and rarity, it is considered vulnerable in Finland.

Calypogeia suecica (Arn. & Perss.) K. Müll. New species on the Finnish list of threatened bryophytes. Included in category 4 in Sweden (Floravårdskommittén för mossor, 1988). Latest

records: Nylandia 1950, Savonia borealis 1956.

According to Schuster (1969) *C. suecica* is restricted to boreal coniferous forests and grows exclusively on decaying wood. Because of its close correlation to primeval forests, it has been added to the list of threatened Finnish bryophytes. The only recent record in Finland is from Kuusamo, where L. Söderström (pers. comm.) saw it in the 1980s. In southern Finland, *C. suecica* has not, however, been encountered since the 1950s despite active searches.

Nowellia curvifolia (Dicks.) Mitt. New species to the Finnish list of threatened bryophytes. Latest records: Regio aboensis 1989 and 1990, Nylandia 1989.

N. curvifolia has a southern distribution in Finland (Buch, 1936). The number of suitable habitats in the southwestern archipelago is rapidly diminishing. It is considered vulnerable in Finland, although it is common in Central Europe and southern Sweden (Schuster, 1974).

Buxbaumia viridis (DC.) Mougl. & Nestl. Included in category 4 in Sweden (Floravårdskommittén för mossor, 1988). Latest records: Ålandia 1989, Regio aboensis 1989 and 1990.

B. viridis has a southwestern distribution in Finland (Oittinen, 1967; Laaka & Syrjänen, 1990). Because of its special ecology and seasonality, it may have been overlooked by bryologists in Finland (Laaka & Syrjänen, 1990). It has declined everywhere in its range in Europe.

In need of monitoring (M)

These species, which because of their ecology occur only at few sites with small and isolated populations, or whose actual status is not clear, need special attention in order to prevent their decline and disappearance from Finland. The species in category 4 are divided into declining (Md), rare (Mr), and poorly known (Mp) species (Rassi & Väisänen, 1987).

Anastrophyllum michauxii (Web.) Buch. In category 4 in Sweden (Floravårdskommittén för mossor, 1988). Latest records: Nylandia 1932, Tavastia australis 1990 (two localities).

A. michauxii has a southern distribution in Finland (Buch, 1936). There are only few recent records from Finland, and because of its rarity, and habitats in old primeval forests, special attention is required to prevent it disappearing from Finland. *A. michauxii* is included in category Mr, rare species.

Jungermannia leiantha Grolle. New species to the list of threatened bryophytes in Finland. Latest records: Regio kuusamoensis 1989, Nylandia 1990.

J. leiantha grows on moist, decaying logs and stumps in spruce mires by springs and brooks. Because it has declined particularly in Southern Finland, and because its suitable habitats are rapidly diminishing, *J. leiantha* is included in the category Md, declining species.

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